LIQUID CRYSTAL DRIVING DEVICE

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Applicant(s): CASIO COMPUT CO LTD

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IPC Classification: C09G3/36; G02F1/133; H04N5/66; H04N9/73

EC Classification:

Equivalents:

Abstract

PURPOSE:To provide a liq. crystal driving device appropriately displaying and driving the white-balance of color liq. crystal.

CONSTITUTION:A signal side driving circuit 1 selects properly a driving voltage V1 and a driving voltage V3 according to display data and a scanning inverting signal to supply it as a display driving signal to respective signal lines SR1, SG1, SB1. At this time, the timing of a driving circuit RC for an R signal is performed by being synchronized with a latch signal L, the timing of a driving circuit GC for a G signal is performed by being synchronized with a display timing signal PG and the timing of a driving circuit BC for a B signal is performed by being synchronized with a display timing signal PB. Thus, the white-balance is appropriately adjusted by adjusting impressing timings of display driving signals of G and B while making R in which the value of (an effective voltage V rms - a transmissivity T) is smallest as a reference and by making transmissivities Te of R, G, B equal while adjusting effective voltages Vs rms OF R, G, B.

NOTICE OF GROUNDS FOR REJECTION

Patent Application No. Hei 10-331493

Examiner: Osamu KOMAKI
Drafted Date: May 12, 2003
Mailed Date: May 20, 2003
Patent Agent for the Applicant: Kenji YOSHIDA and two others
Patent Law Section Applied: Section 29(2)

This patent application should be rejected on the following grounds. The applicant may submit a statement of his/her argument within 60 days from the mailing date of this notice.

GROUNDS

The invention defined in the claims listed below of the present application does not meet the requirements defined in the Patent Law Section 29(2) in that it could have been easily conceived by those having ordinary skill in the art based on inventions disclosed in the publications listed below published in Japan or elsewhere prior to the filing of the present application.

NOTE

- Claims 1-5
- References 1-6
- Remarks

The invention related to Claim 1 does not differ from the inventions disclosed in References 1-3.

There exists no difficulty in employing the known inventions of References 1-3 in a known voltage-controlled birefringent type liquid crystal display device for color display (refer to References 4-6).

Claims 3 and 4 are described in Reference 1 and other documents.

Even without citing example references, the use of polycrystal silicon is well known.

LIST OF CITED REFERENCES

1. Japanese Patent Laid-Open Publication No. Hei 08-016134
2. Japanese Patent Laid-Open Publication No. Hei 07-294889
3. Japanese Patent Laid-Open Publication No. Hei 01-277219
4. Japanese Published Patent No. Hei 07-066124
5. Japanese Patent Laid-Open Publication No. Hei 06-095104
6. Japanese Patent Laid-Open Publication No. Hei 06-273772

整理番号 KHB0980063 発送番号 162074 発送日 平成15年 5月20日 1/ 2

拒絶理由通知書

特許出願の番号	平成10年 特許願 第331498号
起案日	平成15年 5月12日
特許庁審査官	小牧 修　　8004 2X00
特許出願人代理人	吉田 研二 (外 2名) 様
適用条文	第29条第2項

この出願は、次の理由によって拒絶をすべきものである。これについて意見があれば、この通知書の発送の日から60日以内に意見書を提出して下さい。

理 由

この出願の下記の請求項に係る発明は、その出願前日本国内又は外国において頒布された下記の刊行物に記載された発明に基いて、その出願前にその発明の属する技術の分野における通常の知識を有する者が容易に発明をすることができたものであるから、特許法第29条第2項の規定により特許を受けることができない。

期限簿記帳済
庁期限 7月22日
事ケースNo. SY-848

記　　(引用文献等については引用文献等一覧参照)

・請求項1 5
・引用文献1－6
・備考

請求項1に係る発明は引用文献1 3に記載の各発明と差異がない。

カラー表示を行う電圧制御複屈折型の周知（引用文献4－6参照。）の液晶表示装置に引用文献1－3にみられる周知の発明を採用した点に困難な点はない。

請求項3，4については引用文献1などに記載されている。

多結晶シリコンを用いることは引例を示すまでもなく周知。

引 用 文 献 等 一 覧

1. 特開平08－016134号公報
2. 特開平07－294889号公報
3. 特開平01－277219号公報
4. 特公平07－066124号公報
5. 特開平06－095104号公報
6. 特開平06－273772号公報

先行技術文献調査結果の記録

・調査した分野 IPC第7版 G02F 1/13 － 1/141
・先行技術文献 特開平02－302793号公報、特開平06－043462号公報、特開平09－138386号公報、特開平08－106271号公報。
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Japanese Patent Laid-Open Publication No. Hei 8-16134
Laid-Open Date: January 19, 1996
Inventor(s): Koji YAMAGISHI
Applicant(s): Casio Computer, Co. Ltd.
Title of Invention: Liquid Crystal Driving Device

[Detailed Description of the Invention]
[0001]
[Field of Invention]

The present invention relates to a liquid crystal driving device, and more particularly to a liquid crystal driving device which performs driving for favorably controlling the white balance of a color liquid crystal element.

[0002]
[Background Art]

In a liquid crystal display device in which multiplex driving is performed, the structure of the liquid crystal display panel is generally such that a plurality of signal lines and a plurality of scan lines are arranged in a matrix form, and a display element composed of liquid crystal is provided at each of the intersections formed by the signal and scan lines.

[0003]

A display drive signal corresponding to display data is supplied from a signal drive circuit to each signal line. Further, scan drive signals are sequentially supplied from a scan drive circuit to the respective scan lines. In this manner, a liquid crystal element located at an intersection of a signal line and a currently-scanned scan line is applied with an effective voltage generated between the scan drive signal supplied to the scan line and the display drive signal supplied to the signal line. Accordingly, the liquid crystal element is driven to perform display.

[0004]

The above-described driving method is similarly used in both a black-and-white liquid crystal display device and a color liquid crystal display device. However, in a color liquid crystal display device, the signal lines are provided for each of R, G, and B, and display drive signals according to R, G, and B display data are supplied to the respective R, G, and B signal lines.

[0005]

Concerning color display, a liquid crystal element such as TN or STN liquid crystal element for color display is characterized in that the relationship between the applied effective voltage Vrms and the transmittance T differs for R, G, and B, as shown in Fig. 5. When the effective voltage Vrms is higher than a certain value, differences are generated among the transmittance values T of R, G, and B. More specifically, as can be seen from the V-T curve for R indicated by a single-dotted chain line, the V-T curve for G indicated by a dotted line, and the V-T curve for B indicated by a solid line in Fig. 5,

higher transmittance T is obtained in the order of B, G, and R when the same effective voltage Vrms is applied.

[0006]

Accordingly, if the same effective voltage Vrms is applied for R, G, and B in a color liquid crystal display device, the γ characteristic would be varied in the respective wavelength bands for R, G, and B. As a result, the chromaticity coordinates for white when a liquid crystal element is in an all-ON/OFF state (especially in ON state) would be deviated from the proper position.

[0007]

In light of the above, in a conventional liquid crystal driving device for driving a TFT liquid crystal display panel in an analog manner, analog display data values are adjusted for each of R, G, and B, such that the chromaticity coordinates for white are located in the proper position. However, no such adjustments are performed in a conventional liquid crystal driving device of a time-division drive type.

[0008]

[Problem to be Solved by the Invention]

Concerning a conventional liquid crystal driving device, while display data values were adjusted for each of R, G, and B so as to obtain appropriate chromaticity coordinates for white in an analog-drive color liquid crystal driving device, no such adjustments were performed in a liquid crystal driving device of a time-division drive type.

[0009]

As a result, the chromaticity coordinates for white remained deviated from the proper position. It was therefore disadvantageous in that, during an all-ON state (when white is displayed), the white color undesirably became bluish or reddish, and proper color display could not be achieved.

[0010]

The present invention was created in the above light to provide a liquid crystal driving device which adjusts the effective voltage for each of R, G, and B so as to obtain appropriate chromaticity coordinates for white, thereby achieving proper color display.

[0011]

[Means for Solving the Problem]

A liquid crystal driving device according to the present invention comprises a liquid crystal display panel provided with a plurality of R, G, and B pixels in multiple numbers for each of R, G, and B. An R pixel includes an R color filter, a first signal electrode arranged opposing the R color filter, a scan electrode arranged opposing the first signal electrode, and liquid crystal sealed between the two electrodes. A G pixel includes a G color filter, a second signal electrode arranged opposing the G color filter, a scan electrode arranged opposing the second signal electrode, and liquid crystal sealed between the two electrodes. A B pixel includes a B color filter, a third signal electrode arranged opposing the B color filter, a scan electrode arranged opposing the third signal electrode,

and liquid crystal sealed between the two electrodes. Each of the plurality of pixels includes a pair of substrates, and at least one of the substrates is transparent. This liquid crystal display panel is provided with voltage supply means which, when supplying predetermined effective voltages in accordance with a predetermined display drive signal and a scan drive signal to the respective first, second and third signal electrodes and the scan electrodes, supplies the effective voltages at different levels such that transmittance values in the respective R, G, and B pixels become identical. With this arrangement, the present invention achieves the above-described object.

[0012]

As described in Claim 2, the voltage supply means may supply the effective voltages at different levels with respect to the R, G, and B pixels by varying a pulse width of the display drive signal for each of the first, second, and third signal electrodes.

[0013]

Further, as described in Claim 3, the voltage supply means may vary the display drive signal supplied to each of the first, second, and third signal electrodes for the respective R, G, and B pixels by reducing, while using as a reference the pulse width of the display drive signal for the pixel of the color having the lowest transmittance within a predetermined range of γ characteristic in the liquid crystal display panel, the pulse widths of the display drive signal for the pixels of the remaining two colors in accordance with the respective transmittance values.

[0014]

[Achieved Advantages]

According to the present invention, a liquid crystal driving device comprises a liquid crystal display panel provided with a plurality of R, G, and B pixels in multiple numbers for each of R, G, and B. Each of the plurality of pixels includes a pair of substrates, and at least one of the substrates is transparent. In this liquid crystal display panel, when supplying predetermined effective voltages in accordance with a predetermined display drive signal and a scan drive signal to a first signal electrode for an R pixel, a second signal electrode for a G pixel, a third signal electrode for a B pixel, and scan electrodes arranged opposing the respective pixel signal electrodes, voltage supply means allows the effective voltages to be supplied at different levels such that transmittance values in the respective R, G, and B pixels become identical.

[0015]

Transmeittance in the respective R, G, and B pixels can thus be controlled to identical values, such that the chromaticity coordinates for white in the all-ON state is appropriately adjusted, thereby achieving favorable white color display.

[0016]

In such a liquid crystal driving device, the voltage supply means may supply the effective voltages at different levels with respect to the R, G, and B pixels by varying a pulse width of the display drive signal for each of the first to third signal electrodes, as

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described in Claim 2. With this arrangement, values of the effective voltages supplied to the respective display elements for R, G, and B can be adjusted using a simple circuit configuration, allowing low-cost production of a liquid crystal driving device capable of appropriate color display.

[0017]

Further, as described in Claim 3, the voltage supply means may vary the display drive signal supplied to each of the first to third signal electrodes for the respective R, G, and B pixels by reducing, while using as a reference the pulse width of the display drive signal for the pixel of the color having the lowest transmittance within a predetermined range of γ characteristic in the liquid crystal display panel, the pulse widths of the display drive signal for the pixels of the remaining two colors in accordance with the respective transmittance values. With this arrangement, the chromaticity coordinates for white when R, G, and B are all turned on can be more appropriately adjusted by taking into account the γ characteristics and the ON-state transmittance of the liquid crystal, thereby achieving further favorable color display.

[0080]

Operation of the present embodiment is next described.

[0081]

As described above, a liquid crystal element has different γ characteristics for respective R, G, and B. The relationship between effective voltage Vrms and transmittance T differs among R, G, and B as shown in Fig. 5.

[0082]

Specifically, when normally-black liquid crystal elements are used in the liquid crystal display panel 10 of the present embodiment, it can be understood that transmittance T during the ON state differs among R, G, and B as shown in Fig. 5.

[0083]

In the liquid crystal display panel 10, by inputting display drive signals SR, SG, and SB having identical voltage values in the R, G, and B signal lines SR1-SRn, SG1-SGn, and SB1-SBn, respectively, effective voltage Vrms is applied at the same level (the voltage value BV in Fig. 5, for example) to all of the R, G, and B signal lines SR1-SRn, SG1-SGn, and SB1-SBn when scan drive signal Cn is uniform. Under such voltage application, due to the above-described difference in transmittance T during the ON state, the resulting values of transmittance T are varied in a decreasing order of B, G, and R (B>G>R), as shown in Fig. 5.

[0084]

Accordingly, when the liquid crystal display panel 10 is in the ON state, transmittance T becomes varied among R, G, and B, resulting in a bluish or reddish display when displaying all-white.

[0085]

To address this problem, according to the present embodiment, when the effective voltage Vrms transmittance T curves of the liquid crystal display panel 10 are varied in a decreasing order of B, G, and R (B>G>R) as shown in Fig. 5, the values of transmittance T for R, G, and B in the ON state are adjusted to identical values by reducing, according to corresponding differences from the transmittance T for R, the values of effective voltage Vrms generated by the display drive signals SG, SB for the remaining B and G, while using as a reference value the value of effective voltage Vrms generated by display drive signal SR for R having the lowest transmittance T.

[0086]

The signal drive circuit 1 uses the R signal drive circuit RC to control the voltage value and the output timing of the R display drive signal SR.

[0087]

More specifically, the R signal drive circuit RC uses the latch LR11 to latch the display data D in synchronization with sampling clock ST1. Subsequently, this display data D latched by the latch LR11 is further latched in synchronization with the data latch signal L by the latch LR12, and output to the XOR circuit XR1.

[0088]

The XOR circuit XR1 outputs "1" to the level shifter LSR1 when either one of the input display data D or the scan reverse signal M has the value of "1". The level shifter LSR1 amplifies the output level of the signal from the XOR circuit XR1, and outputs this amplified signal to the switch section SWR1.

[0089]

When the switch section SWR1 receives input of "1" from the level shifter LSR1, the switch element SPR11 turns on and supplies drive voltage V1 as the display drive signal SR to the signal line SR1. When receiving input of "0" from the level shifter LSR1, the switch element SPR12 turns on and supplies drive voltage V3 as the display drive signal SR to the signal line SR1.

[0090]

In this manner, as shown in Fig. 3, the R signal drive circuit RC selects either of drive voltage V1 or drive voltage V3 in accordance with the display data D and the scan reverse signal M, and supplies the selected signal as the display drive signal SR to the signal line SR1. The supply timing of the display drive signal SR to the signal line SR1 is synchronized with the data latch signal L, as shown in Figs. 3 and 4.

[0091]

During the above process, the scan drive signal Cn shown in Fig. 4 is supplied to the scan lines of the liquid crystal display panel 10.

[0092]

In the present liquid crystal display panel 10, assuming that the drive time-division number is N and the bias ratio of the effective voltage Vrms is a, the pulse

width of the scan drive signal Cn and display drive signal is 1/N.

[0093]

In order to drive the liquid crystal display panel 10 by an alternating current, drive voltage V0 and drive voltage V4 (V0>V4) generated with respect to a reference voltage of drive voltage V2 are alternately applied as the scan drive signal Cn to the scan lines in accordance with the alternator signal M.

[0094]

Accordingly, the effective voltage VRrms expressed by the following equation is applied to the R signal lines SR1-SRn.

[0095]

$$VRrms = V0\,[\{(1+1/a)^2 + (N-1)\,(1/a)^2\}\,/\,N]^{1/2}$$

Subsequently, the signal drive circuit 1 uses the G signal drive circuit GC to control the voltage value and the output timing of the G display drive signal SG, thereby controlling the pulse width of the G effective voltage VGrms and adjusting the voltage value of the G effective voltage VGrms.

[0117]

As described above, according to the present embodiment, the scan drive signal Cn is supplied by the scan drive circuit to the scan lines of the liquid crystal display panel 10. Further, display drive signals having voltage values corresponding to the display data D for R, G, and B are supplied from the signal drive circuit 1 to the R, G, and B signal lines SR1-SRn, SG1-SGn, and SB1-SBn, respectively, so as to perform color display in the liquid crystal elements (display elements) for R, G, and B formed at the intersections of the signal lines SR1-SRn, SG1-SGn, and SB1-SBn and the scan lines. When performing such color display, the present embodiment allows adjustments to be made in the application timings of the display drive signals SR, SG, and SB supplied from the signal drive circuit 1 to the respective R, G, and B signal lines SR1-SRn, SG1-SGn, and SB1-SBn of the liquid crystal display panel 10.

[0118]

Accordingly, values of the effective voltages VRrms, VGrms, and VBrms applied to the liquid crystal elements for R, G, and B, respectively, can be appropriately controlled, such that transmittance T values for R, G, and B become identical.

[0119]

As a result, the chromaticity coordinates for white in the all-ON state can be adjusted to the proper position, achieving appropriate white color display.

[0120]

Further, according to the present embodiment, the R, G, and B effective voltages VRrms, VGrms, and VBrms are controlled discretely for the respective R, G, and B signal lines SR1-SRn, SG1-SGn, and SB1-SBn based on the γ characteristics of the liquid crystal

display panel 10. The chromaticity coordinates for white in the all-ON state can thus be more appropriately adjusted by taking into account the γ characteristics of the liquid crystal, thereby achieving further favorable color display.

[0121]

Moreover, according to the present embodiment, values of the effective voltages VRrms, VGrms, and VBrms applied to the respective liquid crystal elements for R, G, and B are controlled by changing the application timings of the display drive signals SR, SG, and SB. Accordingly, values of the effective voltages VRrms, VGrms, and VBrms applied to the respective liquid crystal elements for R, G, and B can be adjusted using a simple circuit configuration. This allows low-cost production of a liquid crystal driving device capable of appropriate color display.

[0122]

Further, according to the present embodiment, values of the effective voltages VRrms, VGrms, and VBrms applied to the respective liquid crystal elements for R, G, and B are controlled by shifting, while using as a reference one of the display drive signals SR, SG, and SB for R, G, and B concerning which the liquid crystal exhibits the lowest γ characteristic and having the lowest transmittance when the liquid crystal element is turned on, the application timings of the remaining two of the display drive signals SR, SG, and SB. In this manner, the chromaticity coordinates for white when R, G, and B are all turned on can be more appropriately adjusted by taking into account the γ characteristics and the ON-state transmittance of the liquid crystal, thereby achieving further favorable color display.

[0123]

While the invention conceived by the present inventors is specifically described above referring to a preferred embodiment, the present invention is not limited to the described embodiment. It should be apparent that various modifications can be made without deviating from the scope of the present invention.

[0124]

For example, while normally-black liquid crystal elements are employed in the liquid crystal display panel 10 according to the above embodiment, normally-white elements may alternatively be used. In that case, because the effective voltage Vrms - transmittance T characteristic would become inverted from that shown in Fig. 5, an effective voltage Vrms determined while taking into account such a V-T characteristic must be applied to each of the R, G, and B signal lines.

[0125]

In the above embodiment, no adjustment of effective voltage Vrms is made concerning a display drive signal applied when a signal line is not selected, because the effective voltage Vrms - transmittance T curves for R, G, and B are identical in the OFF state, as can be seen in Fig. 5. When using a liquid crystal in which the V-T curves for R, G, and B are not identical in the OFF state, the effective voltages Vrms for R, G, and B

may also be adjusted in the OFF state.

[0126]

Further, in the above embodiment, the time point at which a display drive signal pulse is generated is shifted so as to adjust the pulse width of the effective voltage Vrms that is generated between the display drive signal and the scan drive signal Cn and applied to the liquid crystal. However, other arrangements are also possible. Alternatively, the pulse width of the display drive signal may be adjusted.

[0127]

Moreover, while the value of effective voltage Vrms applied to the liquid crystal is adjusted by controlling the pulse width of the effective voltage Vrms in the above embodiment, it is also possible to adjust the voltage value of the display drive signal so as to directly control the value of effective voltage Vrms.

[Brief Description of the Drawings]

[Fig. 1] A circuit diagram showing one embodiment of a signal drive circuit of a liquid crystal driving device according to the present invention.

[Fig. 2] A side cross-sectional view of a liquid crystal display panel to be driven by the drive circuit of Fig. 1.

[Fig. 3] A timing chart showing signals in the respective sections of the signal drive circuit of Fig. 1.

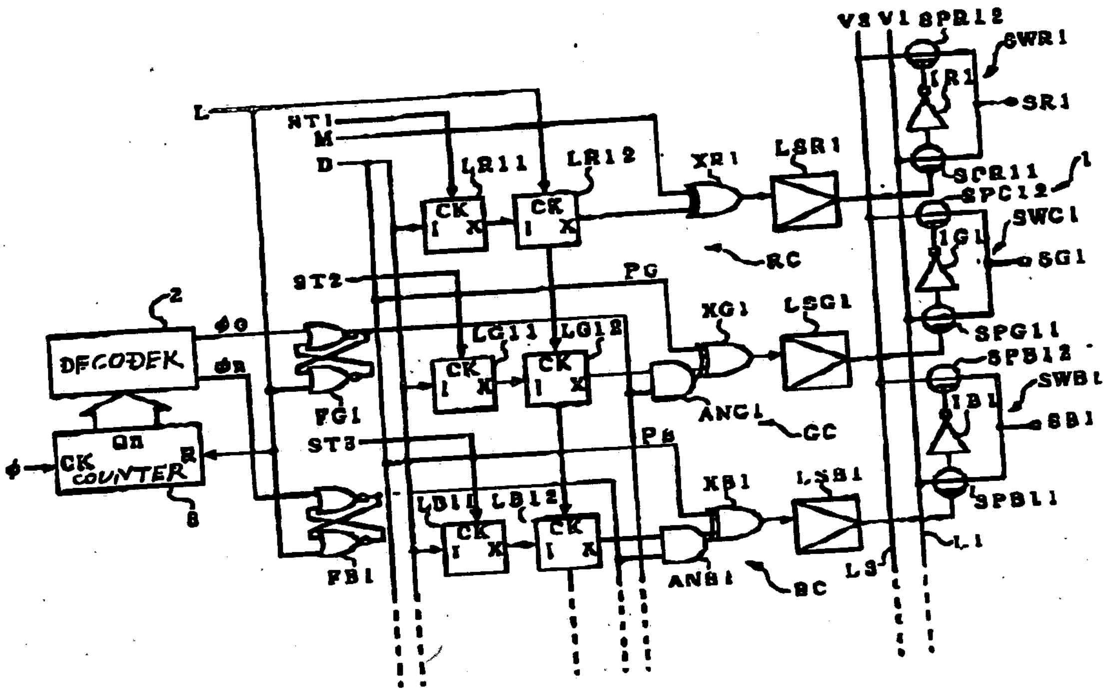
[Fig. 4] A timing chart showing display drive signals supplied by the signal drive circuit of Fig. 1 to the signal lines and a scan drive signal.

[Fig. 5] A diagram showing the effective voltage Vrms - transmittance T curves of the liquid crystal display panel.

[Reference Numerals]

1 signal drive circuit
2 decoder
3 counter
10 liquid crystal display panel
11a, 11b transparent glass substrate
12 liquid crystal
13R, 13G, 13B color filter
14, 16 alignment film
15 scan line
17a, 17b polarization plate
SR1-SRn, SG1-SGn, SB1-SBn signal line
LR11, LR12, LG11, LG12, LB11, LB12 latch
XR1, XG1, XB1 XOR circuit
ANG1, ANB1 AND circuit

LSR1, LSG1, LSB1 level shifter
SWR1, SWG1, SWB1 switch section
SPR11, SPR12 switch element
SPG11, SPG12 switch element
SPB11, SPB12 switch element
IR1, IG1, IB1 inverter
FG1, FB1 flip-flop
L1, L2 power line


V2 V1 SPR12
SWR1
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ST1
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SWC1
IG1
SG1
RC
ST2
PG
XG1
LSG1
SPG11
SPB12
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Fig. 1

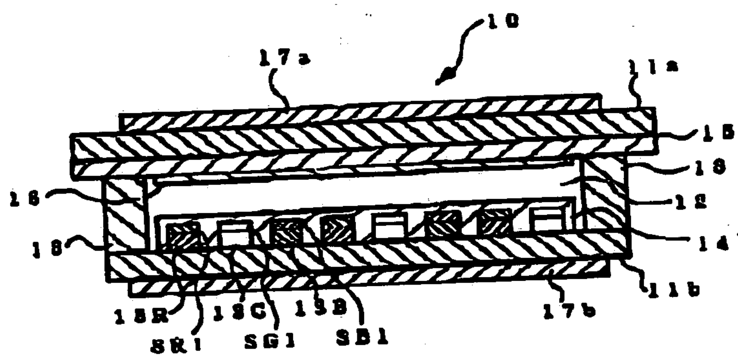

Fig. 2

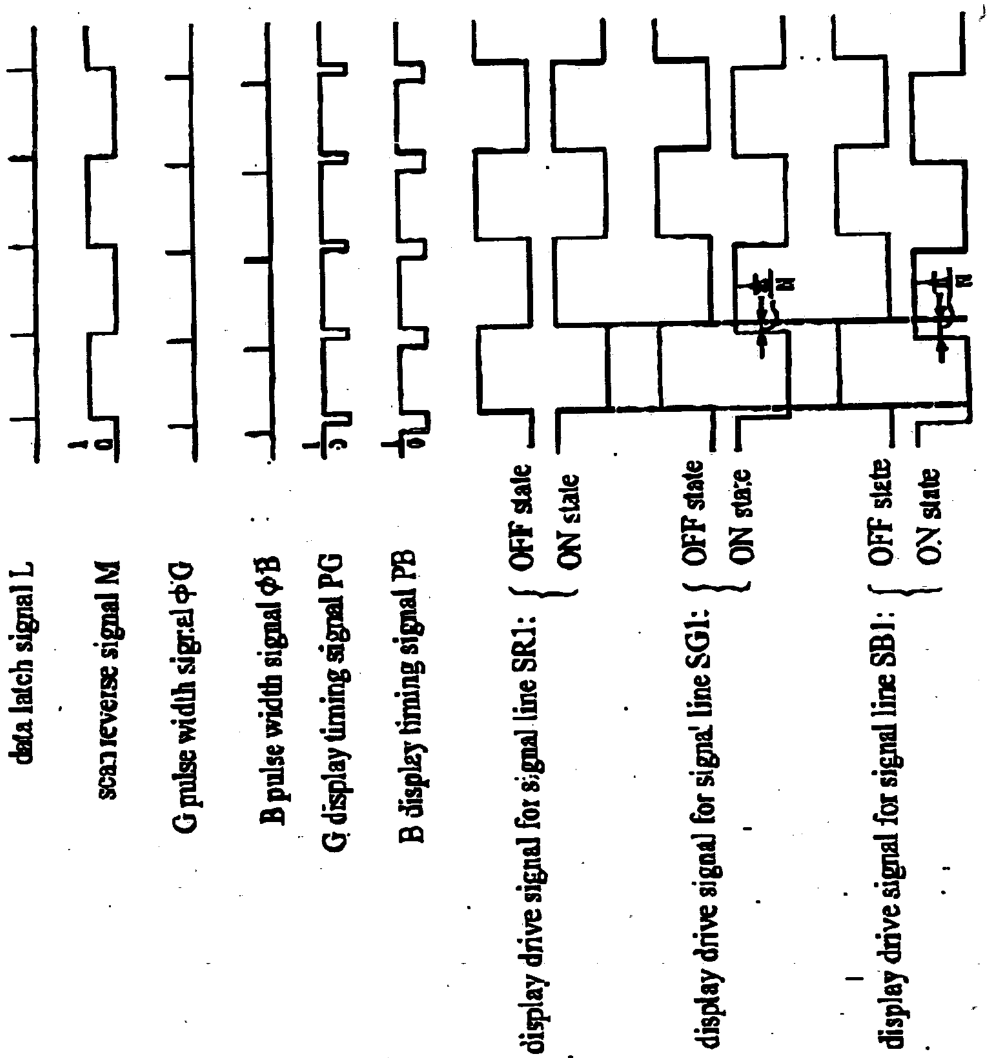
data latch signal L
scan reverse signal M
G pulse width signal ΦG
B pulse width signal ΦB
G display timing signal PG
B display timing signal PB
display drive signal for signal line SR1:
OFF state
ON state
display drive signal for signal line SG1:
OFF state
ON state
display drive signal for signal line SB1:
OFF state
ON state
1
0

Fig. 3

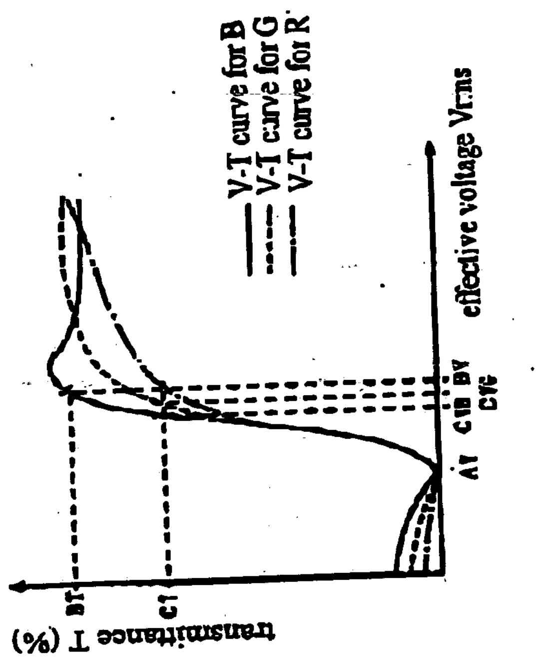
V-T curve for B
V-T curve for G
V-T curve for R
effective voltage Vrms
transmittance T (%)
BT
CT
AV
CTB
BV
CVG

Fig. 5

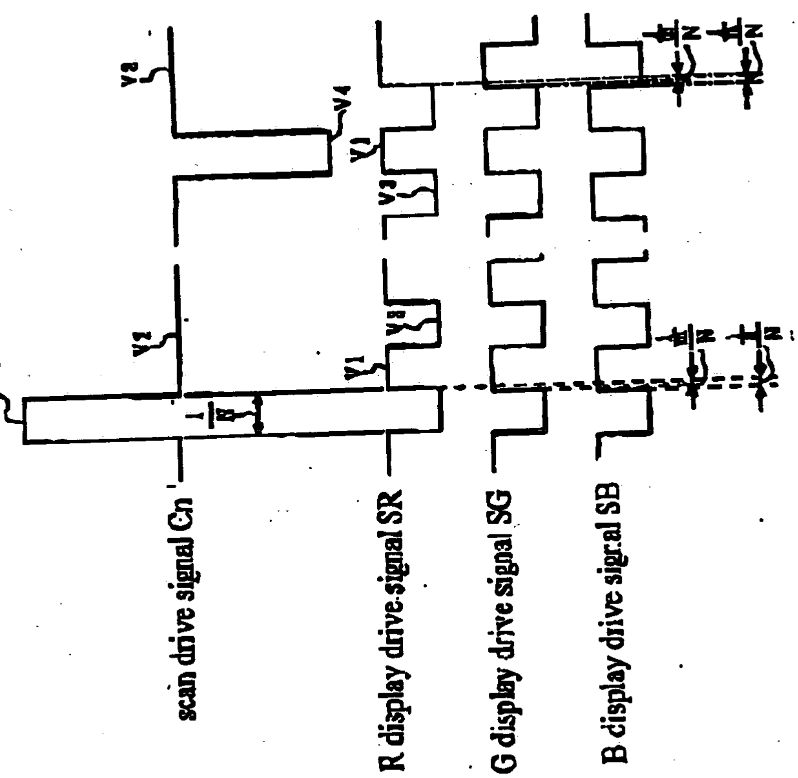
scan drive signal Cn
R display drive signal SR
G display drive signal SG
B display drive signal SB
V2
V4
V1
V3

Fig. 4

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